



30 SEP 2004

10/510016



INVESTOR IN PEOPLE

BEST AVAILABLE COPY

**PRIORITY
DOCUMENT**

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

The Patent Office
Concept House

Cardiff Road

Newport REC'D 13 JUN 2003

South Wales

NP10 8QQ WIPO PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

[Signature]

Dated 15 May 2003

Patents Form 1/77

Patents Act 1977
(Rule 16)



1/77

02APR02 E707799-3 D10002
P01/7700 0.00-0207563.8

The Patent Office

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

-2 APR 2002

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference	sps.2169.uk.dk/ac.b		
2. Patent application number (The Patent Office will fill in this part)	0207563.8		
3. Full name, address and postcode of the or of each applicant (underline all surnames)	SPS-AFOS Group Limited Arnhall Business Park Westhill ABERDEEN AB32 6UF Patents ADP number (if you know it) If the applicant is a corporate body, give the country/state of its incorporation		
	UK 8001398001		
4. Title of the invention	Junk removal tool		
5. Name of your agent (if you have one)	Kennedys Patent Agency Limited Floor 5, Queens House 29 St Vincent Place GLASGOW G1 2DT United Kingdom Patents ADP number (if you know it)		
	8058240001		
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)	
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	Yes		

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 12

Claim(s)

Abstract

Drawing(s)

3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents

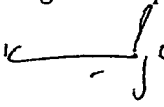
Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.
- | | | |
|-----------|--|---------------|
| Signature |  | Date |
| KENNEDYS | | 29 March 2002 |
12. Name and daytime telephone number of person to contact in the United Kingdom
- | |
|--------------------|
| David Kennedy |
| tel: 0141 226 6826 |

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

1 Junk removal tool

2

3 The present invention relates to downhole tools for use
4 in removing junk from a well bore.

5

6 When drilling or completing a well bore, it is accepted
7 that a large amount of junk can be present within the
8 well bore. Such junk may comprise debris which are
9 generally considered to be small particles of such things
10 as metal shavings, chips, twists or curls, together with
11 particles of cement or scale which may have previously
12 appeared on the walls of casing or liner. In this group
13 is included mud and other particulates found in fluids
14 circulated within the well bore. A further category of
15 junk is larger objects. These may include portions of
16 tools which have been discarded within the well bore,
17 become broken or large sections of the tubulars which
18 have been cut away when portions of the casing or liner
19 have been milled or drilled, for example, following
20 casing milling or window cutting. Additionally such junk
21 can be produced after perforation.

22

1 A number of downhole tools have been developed for
2 collecting and retrieving junk found in a well bore.
3 This Application is primarily directed towards the
4 collection of large pieces of junk which cannot be
5 circulated out of the well bore.

6
7 Apparatus within a well bore designed to collect junk
8 primarily fall into two categories dependent upon the
9 location of the tool on a work string. The first
10 category relates to apparatus mounted at the bottom of
11 the work string. This apparatus collects all fluids and
12 materials within the well bore as fluids are circulated
13 up the well bore or as the tool is run into the well
14 bore. Such tools are typically referred to as junk
15 catchers and an example is that disclosed in US Patent
16 4,515,212 to Marathon. This tool has a collection of
17 petals arranged at the distal end of the work string. As
18 the tool is run into the well, the petals are forced
19 outward to the walls of the well bore where they act to
20 siphon all material through the a single large port on
21 the longitudinal axis of the tool. When the tool is
22 pulled from the well the petals close thereby catching
23 large debris and pulling it from the well.

24
25 A significant disadvantage of this tool is that it must
26 be positioned at the end of a work string and thus is
27 typically used on a single run. To operate a dedicated
28 run merely for the purposes of clearing junk is both
29 time-consuming and expensive.

30

31 The second category of junk catchers can be mounted at
32 any position on a work string to allow the tool to be run
33 at the same time as other tools. A tool of this type is

disclosed in US Patent 6,176,311 to Baker Hughes Incorporated. The tool has a wiper or scraper blade arranged to prevent the fluid including the junk to pass up the annulus between the tool and the well bore wall. The fluid including the junk is forced into a port and through a passage in the tool around the wiper. A filter and a trap are positioned within the passage to catch the junk, which is too large to pass through the filter.

Such tools have a disadvantage in that they can only handle smaller pieces of junk, generally referred to as debris. This is because the input port is sized to ensure that a significant flow velocity is maintained to circulate the fluid through the tool. As a result of this narrow flow path, these tools generally include a by-pass means which ruptures to allow the fluid to escape when the filter has been clogged with large debris. Thus, when large debris is present the tool cannot function correctly and, in fact, generally shuts down into a mode that allows the fluid including the junk to by-pass the tool. Additionally, junk tends to 'ball-up' at the scrapers or wipers as the larger pieces of junk are swept away from the inlet port up the annulus to become jammed or located around the wiper blades.

It is an object of at least one embodiment of the present invention to provide a downhole tool which can be positioned anywhere on a work string and which can collect large pieces of junk from within the well bore.

It is a further object of at least one embodiment of the present invention to provide a downhole tool for collecting or retrieving junk from a well bore which can

1 break up large pieces of junk so that they can be
2 collected and retrieved from the well bore.

3
4 According to a first aspect of the present invention,
5 there is provided a downhole tool for collecting and
6 retrieving junk from a well bore, the tool comprising a
7 cylindrical body attachable in a work string, a multi-
8 faceted surface arranged at an end of the body for
9 contacting with and breaking up junk and a plurality of
10 inlet ports through which the broken up junk passes into
11 a trap for collection.

12
13 Thus the tool is suitable for retrieving large pieces of
14 junk by breaking up the junk before collection. In
15 addition the plurality of input ports provide a large
16 access area to gather the broken junk into the trap.

17
18 Preferably the multi-faceted surface comprises a
19 plurality of projections, each projection being located
20 between adjacent inlet ports. More preferably the
21 projections include a plurality of tungsten carbide
22 coated surfaces to provide a grinding and/or milling
23 action to assist in breaking up the junk.

24
25 Preferably the tool includes a sleeve located around the
26 body, the sleeve including filter means for filtering
27 debris from fluid passing there through. Preferably also
28 the trap is provided in an annular space between the body
29 and the sleeve.

30
31 Preferably, the sleeve is detachable. This is arranged
32 so that when the tool is pulled from the hole the sleeve
33 can be removed and the junk can be disposed of.

1 Preferably, the inlet ports are arranged equidistantly
2 around the cylindrical body. Advantageously the ports are
3 perpendicular to a longitudinal axis of the tool so that
4 they are in the flow path. There may be four inlet ports.

5
6 Advantageously, each inlet port includes a valve to
7 prevent debris from falling back through the port once it
8 has entered. Preferably, the valves are flap valves.
9 These flap valves may be operated by a spring so that
10 they can be opened by fluid pressure but are urged to a
11 closed position.

12
13 Preferably, also, the tool includes a throat. The throat
14 may be a cylindrical body located adjacent to the
15 projections such that the diameter of the throat is
16 narrower than the diameter of the sleeve to allow a clear
17 access to the inlet ports.

18
19 Preferably the cylindrical body includes an axial bore to
20 permit fluid flow through the work string.

21
22 Preferably, also, the tool may include one or more
23 milling elements designed to be run in ahead of the
24 projections. Such an arrangement of additional milling
25 heads will tend to jet the junk towards the projections
26 and inlet ports of the tool.

27
28 According to a second aspect of the present invention,
29 there is provided a method of collecting and retrieving
30 junk within a well bore, comprising the steps:

31

- 1 (a) providing a multi-faceted contact surface on a work
- 2 string, the surface including a plurality of inlet
- 3 ports;
- 4 (b) breaking up large pieces of junk by contact with the
- 5 surface;
- 6 (c) collecting the broken-up junk through the inlet
- 7 ports; and
- 8 (d) storing the broken-up junk in a trap adjacent the
- 9 inlet ports.

10

11 Preferably, also, the method may further include the step
12 of providing a mill ahead of the surface and jet milled
13 junk from the mill towards the inlet ports.

14

15 Preferably, also, the method includes the step of
16 operating one or more valves at each inlet to prevent the
17 broken-up junk from exiting the trap.

18

19 An embodiment of the present invention will now be
20 described, by way of example only, with reference to the
21 accompanying figures of which:

22

- 23 - Figure 1 is a part cross-sectional view of a
- 24 downhole tool according to an embodiment of the
- 25 present invention;
- 26 - Figure 2 is a cross-sectional view of the downhole
- 27 tool of Figure 1 through section line A - A'; and
- 28 - Figure 3 is a downhole tool arranged on a work
- 29 string according to a further embodiment of the
- 30 present invention.

31

32 Reference is initially made to Figure 1 of the drawings,
33 which illustrates a downhole tool, generally indicated by

1 Reference Numeral 10, according to an embodiment of the
2 present invention. Tool 10 comprises a cylindrical body
3 12, having an upper end 14 and a lower end 16. It will
4 be appreciated that the reference to upper and lower can
5 be considered to relate to the position with respect to
6 the entry port of the well bore and thus the tool can be
7 used in a vertical, inclined or horizontal position as
8 required. At the upper end 14 of the tool 10 there is
9 located a box section 18 for connection of the tool to a
10 work string (not shown). At the lower end 16 there is a
11 pin section 20 for connection of the tool 10 to the lower
12 portion of the drill string (not shown). As will be
13 appreciated, the tool 10 can be inserted within a work
14 string. Body 12 includes an axial bore 22 providing an
15 access for fluid from the upper end 14 to the lower end
16 of the tool through a longitudinal axis.

17

18 Located around the body 12 is a sleeve 24. Sleeve 24
19 provides a thin annular wall 26, which includes ports 28,
20 30. Ports 28, 30 allow for the passage of fluid and
21 small debris to exit the tool 10 via the sleeve 26. This
22 can be seen from the Figure, ports 28 are larger than
23 ports 30 and are arranged towards the upper end 14 of the
24 tool.

25

26 Sleeve 24 is held in place via connecting screws 32 which
27 locate through a port 34 on the body 12. Screws 32 are
28 inserted into the port 34 and contact a conical spring 36
29 which assists in holding the screw 32 in place. When
30 mounted there is provided a trap 31 formed by an annular
31 space created between the body 12 and the sleeve wall 26.

32

1 Further ports 38 are arranged on the body 12 to provide a
2 substantially longitudinal exit path to expel fluid and
3 small debris from sleeve 24 outwith the body 12.

4
5 At the lower end of the sleeve 24 there are arranged
6 inlet ports 40. Each inlet port includes a flapper valve
7 41. Reference is now made to Figure 2 of the drawings,
8 which illustrates a cross-sectional view through the tool
9 of Figure 1 at the location of the inlet ports 40. Four
10 inlet ports 40A-D are arranged on the tool being
11 equidistantly spaced around the central bore 22. Each
12 inlet port 40A-D has a square cross-sectional area and
13 together the inlet ports 40A-D provide a substantial flow
14 path for junk into the tool. In the embodiment shown the
15 sleeve 24 has a diameter 8.25 inches and each inlet port
16 is a 2 inch x 2 inch square.

17
18 Valves 41 are flow assisted so that they open under flow
19 of material and are spring assisted to close.

20
21 Below the sleeve 24, is located a multi-faceted surface
22 42 on the body 12. Multi-faceted surface 42 comprises a
23 number of projections 44. In the embodiment shown there
24 are four projections, each located between adjacent inlet
25 ports 40. Thus, a channel 46 exists between neighbouring
26 projections to direct fluid and junk into the inlet ports
27 40.

28
29 Each projection 44 has a plurality of surfaces. One
30 surface is a transverse surface 48, perpendicular to the
31 axis of the tool. The transverse surface 48 is arranged
32 to contact the top of a polished bore receptacle when the
33 tool 10 is run into a well bore. The surface 42 has a

1 coating of tungsten carbide so that the projections 44
2 can provide a milling action when moved against a surface
3 in the well bore e.g. a polished bore receptacle or a
4 large piece of junk. Further, the projections include a
5 raised surface 50 which assist in stabilising the tool
6 within the well bore and thus the projections 42 can be
7 considered as stabilisation blades.

8
9 Located below the projections 44 is a throat portion 52
10 of the tool 10. Throat portion 52 has a cylindrical body
11 with a diameter which is smaller than the diameter of the
12 sleeve 24. This provides a throat area for junk to be
13 swept into the channels 46 for entry through the inlet
14 ports 40.

15
16 In use the tool is connected to a work string via the box
17 section 18 and the pin section 16. The tool can be run
18 on the same trip as a pre-completion mechanical well bore
19 clean-up run or during a dedicated junk clean-out run.
20 The tool is run into the well bore and can be run to a
21 location where the tangential surface 48 lands on the
22 liner top of a polished bore receptacle and the clean-up
23 string is at TD. The tool can then be rotated to drill /
24 mill / polish any assemblies via rotation and
25 reciprocation as the multi-faceted surface 42 of the
26 projections 44 can contact the walls of the well bore.

27
28 When run into a well bore or alternatively when fluid is
29 circulated towards the tool, junk will be located in the
30 fluid and be forced passed the throat 52 and into the
31 large inlet ports 40 via the flapper valves 41. Due to
32 the flow against the flapper valves 41 they will open and
33 the junk laden fluid will enter the trap 31. The fluid

1 and small debris can exit through the ports 30, 28, 38
2 while the larger debris will become trapped and be
3 retained in the trap 31. Debris and junk which is larger
4 than the size of an inlet port 40 will be broken up by
5 the multi-faceted surface 42 on the projections 44.
6 Thus, large pieces of junk cut up and shattered on the
7 projections 42 and drawn in to the trap 31 through the
8 inlet ports 40. The size and location of the projections
9 42 ensure that the junk is broken up into pieces which
10 can fit in the channels 46 and thus through the inlet
11 ports 40. The diameter of the throat 52 provides a
12 maximum by-pass swallowing capacity also.

13
14 When work is complete and the tool is withdrawn from the
15 hole or remains stationary at a point in the well bore,
16 flapper valves 41 will automatically close via the spring
17 connections and the junk within the trap 31 is prevented
18 from falling out of the tool 10 as the tool is raised to
19 the surface, or when the flow is removed from an upward
20 direction in relation to the tool position.

21
22 As the inlet ports 40 are arranged uniformly around the
23 central bore 22, significant amounts of junk can be
24 collected within the tool and raised to the surface.

25
26 Reference is now made to Figure 3 of the drawings, which
27 illustrates the tool 10 including a mill 54 run ahead of
28 the tool 10 on a work string 56. The mill 54 is located
29 at a bottom end 16 of the tool 10. Like parts of the
30 tool to those of Figures 1 and 2 have been given the same
31 reference numeral. In this embodiment mill 54 may act as
32 a pilot mill to drill or mill up pieces of junk which can
33 then be jetted in through the channels 46 into ports 40

1 to the trap 31. This embodiment of the invention is
2 suitable to be run after casing milling or window cutting
3 operations to collect larger pieces of milling debris
4 that are sometimes produced during these operations and
5 could not be removed otherwise. The tool is also
6 suitable for running through already perforated pipe to
7 clean-up or remove perforating damage that restricts the
8 inner diameter of the well bore and retrieve any
9 perforation debris that cannot be circulated out of the
10 well bore. Further, the mill 54 can be used to act as a
11 tie back mill to clean out the inner diameter of a
12 polished bore receptacle when the projections 44 and, in
13 particular, the transverse surface 48 are landed on a
14 polished bore receptacle and used to dress off the
15 polished bore receptacle lip. Thus, it will be
16 appreciated that multi-faceted surface 42 acts as an
17 integral liner top dress mill on the tool 10.

18

19 The principal advantage of the present invention is that
20 it provides a tool capable of capturing large pieces of
21 junk or debris in a well bore by breaking up the junk and
22 then collecting the junk in a trap.

23

24 A further advantage of the present invention is that by
25 the use of a throat portion the junk laden fluid is
26 jetted in to the trap for collection. This results in a
27 tool which does not require to be rotated to create a
28 centrifugal force to drive fluid through the tool and can
29 therefore be operated by either being run into a well
30 bore or via circulation of fluid upwards through the
31 inlet ports 40.

32

1 A yet further advantage of the debris removal tool is
2 that it can be operated on any portion of a work string
3 and by virtue of the central bore 22 a separate fluid
4 path is created so that fluids can be taken up or
5 downhole separate from the fluid being attracted into the
6 trap 31. Thus the tool can be operated on a drill string.

7
8 Various modifications may be made to the invention herein
9 described without departing from the scope thereof. For
10 instance, the number, size and arrangement of the ports
11 40 can be adjusted as long as there remains a large input
12 surface into the trap to collect the larger pieces of
13 junk. Further, it will be appreciated that the tool can
14 be run with any other form of cleaning tool such as
15 brushes and scrapers as long as they do not obstruct the
16 passage of large junk being pushed towards the multi-
17 faceted surface 42 for milling and grinding to be broken-
18 up and thereby enter the ports 40.

19
20 Further, it will be appreciated that the ports on the
21 sleeve can be varied in size, depending on the debris
22 size which is acceptable within the well bore. If the
23 fluid is to be entirely screened, then a screen or wire
24 mesh filter may be appropriate.

1/3

INFORMAL

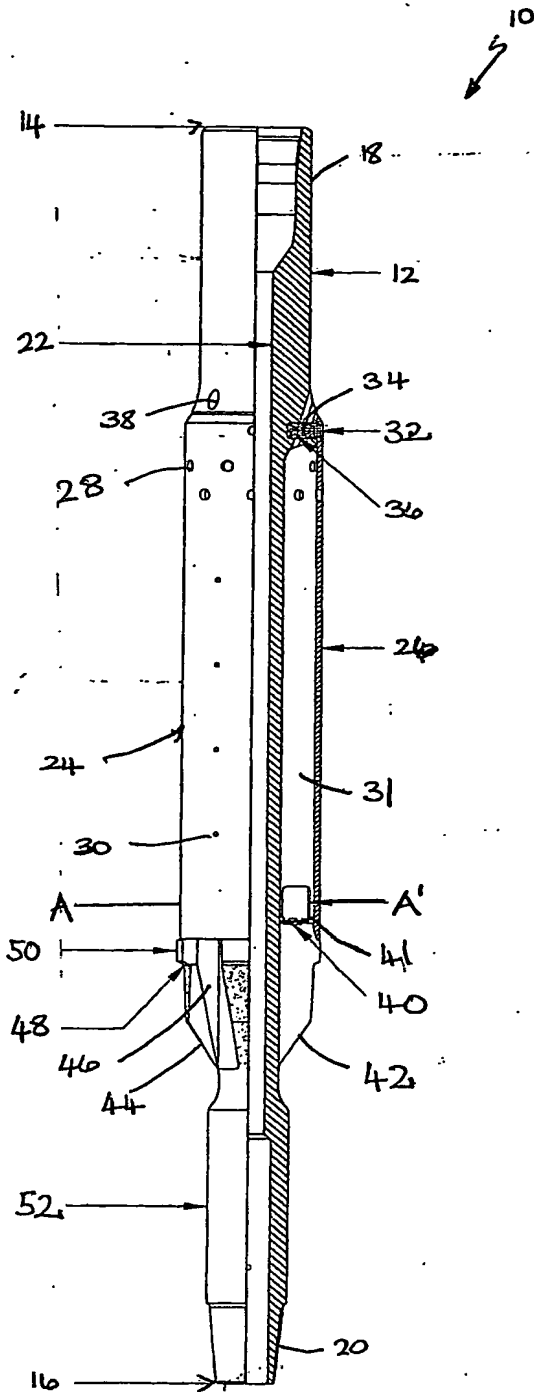
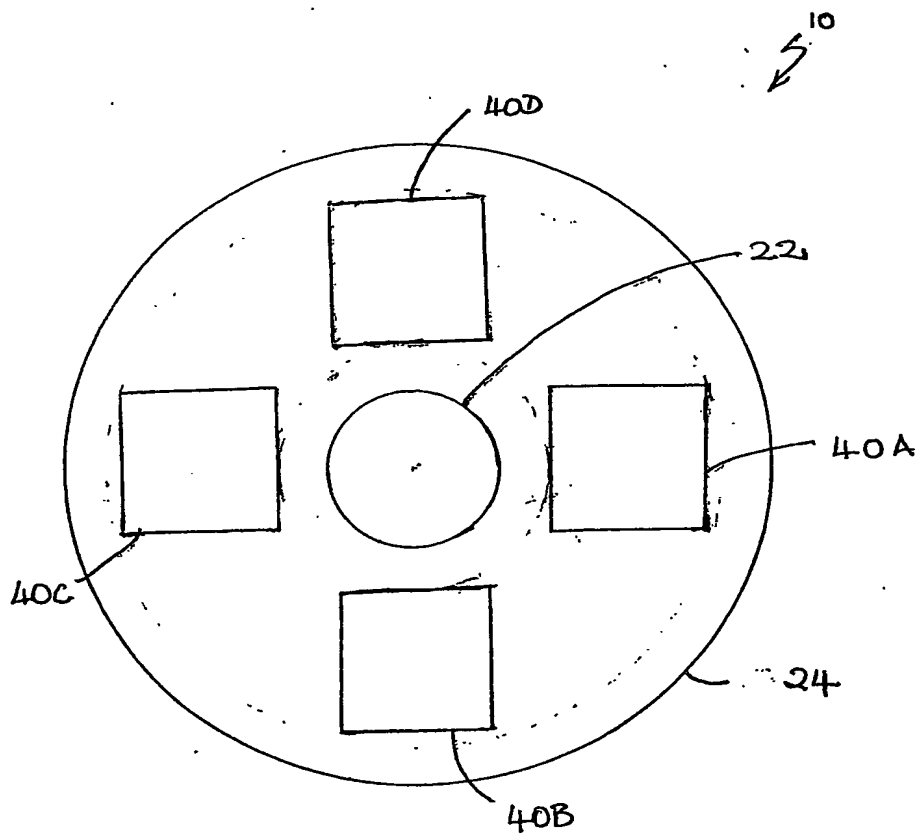


FIGURE 1

INFORMAL

FIGURE 2

INFORMAL

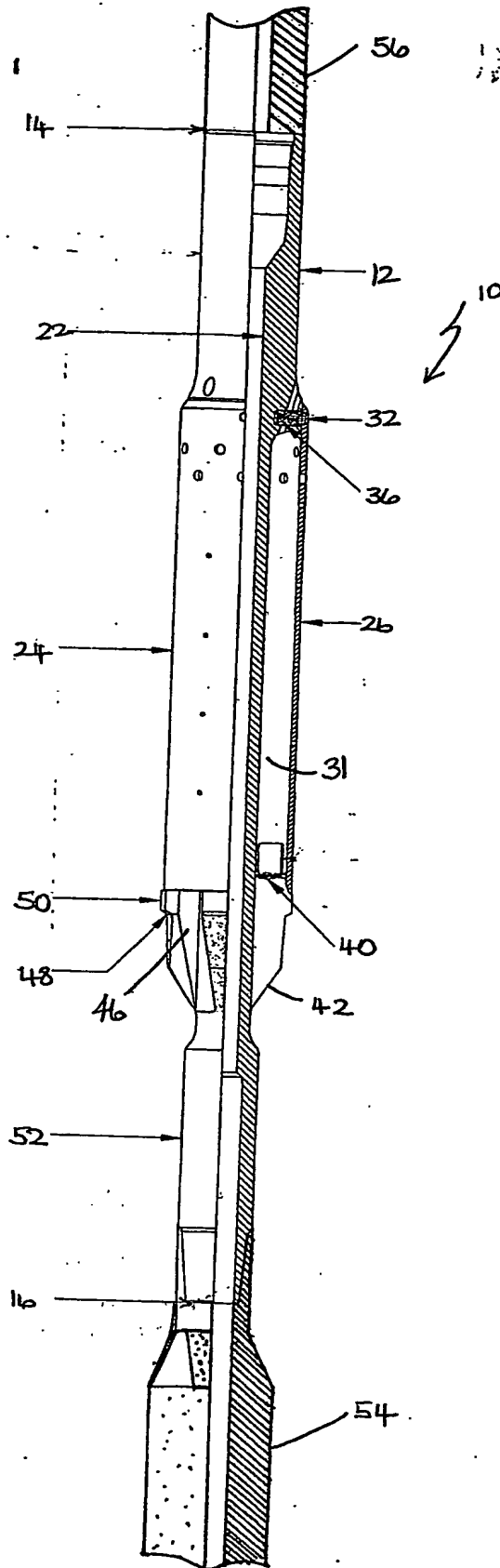


FIGURE 3

THE PATENT OFFICE

16 MAY 2003

Received in Patents
International Unit

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☒ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.